Developing Traditional Forensic Science Exploitation of Contaminated Exhibits Recovered from a Nuclear Security Event

G. Graham¹,4, S. McOmish¹, K. Rayment², R. Robson² and R. Baldwin³
¹Atomic Weapons Establishment, Aldermaston, Reading, UK
²Forensic Access Ltd, Wantage, UK
³Directorate of Forensic Services, Metropolitan Police Service, London, UK
⁴Institute for Security Science and Technology, Imperial College, London, UK

Web: www.awe.co.uk
Introduction

- The investigation resulting from the malicious use of nuclear and other radiological material outside of regulatory control will require scientific support:
  
  1. Analyses of the recovered “unknown” nuclear / other radiological material
  2. Examination of associated material / items (packaging/documents etc) recovered from the contaminated crime scene

- The examination of the associated material / items will aim to recover fingerprints, DNA, hairs and fibre etc…

- Traditional forensic science examination on exhibits contaminated with nuclear and other radioactive material can be problematic…
### Traditional Forensic Science Examinations on Exhibits Contaminated with Nuclear or other Radioactive Material

<table>
<thead>
<tr>
<th>Traditional Forensic Science Laboratories</th>
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<tr>
<td>- Laboratories not licensed to handle nuclear and other radioactive material</td>
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<td>- Laboratories not designed for operations with nuclear and other radioactive material</td>
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<tr>
<td>- Staff not trained to handle nuclear and other radioactive material</td>
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<td>- Expertise in traditional forensic science disciplines</td>
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<td>- Laboratories not equipped to undertake traditional forensic science</td>
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Enabling Traditional Forensic Science Examinations on Contaminated Items

- Solution...enable traditional forensic scientists to perform their examinations in a suitable controlled environment under appropriate radiological protection supervision

- Office for Security & Counter-Terrorism, Home Office (UK) funded the development of a specialist laboratory at AWE

- The project utilised:
  - AWE expertise in nuclear materials
  - Traditional forensic science expertise from:
    - The Metropolitan Police Forensic Science Directorate
    - Dedicated Forensic science service provider
    - Forensic Explosive Laboratory
    - Home Office Centre for Applied Science & Technology

End-User Requirements
The CFAC Laboratory

- Laboratory licensed to handle radiological material
- Laboratory designed for operations with radiological materials
- Laboratory able to receive RN+E contaminated exhibits
- AWE providing technical advice on dealing with the radiological hazard
- Forensic practitioners from external organisations (e.g. the Police) trained to work within the laboratory
- Traditional forensic science examinations to a standard acceptable to UK Court of Law
- Broad range of traditional forensic science examinations possible:
  - Record photography
  - Swabbing for DNA
  - Trace evidence recovery
  - Digital data recovery
  - Fingerprints
  - Questioned Documents
The CFAC Laboratory

360° tour generated by Darren Jones (SCO4)

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Glove Box Units for Exhibit Examinations

- Two dedicated glove box units designed to examine exhibits contaminated with nuclear or other radioactive material
  - CNA chamber for fingerprint development incorporated into the glove box
Forensic Examinations within the Lab

- Broad range of more detailed examinations can be performed around laboratory, including:
  - Questioned Document analysis
  - Trace evidence examinations, e.g. comparison microscopy
  - Digital data recovery from mobile phones
Operating Model for the CFAC Laboratory

- External Forensic Scientists to undertake the casework examinations after training to operate in a glove-box with support from technical specialists from AWE (e.g. radiological protection advice)
Challenges of Operating in a Glove-Box

- Different environment to the “normal” forensic science laboratory…co-existing disciplines all in the same space
  - Requires a different approach to examinations yet still maintaining the standards expected for forensics!
Validation & Method Development

- Transferring methods and procedures from “home” laboratory to the CFAC
  - Fingerprints, QD, Trace, DNA, Digital etc
- Adapting methods for use in the CFAC
- Develop SOPs for accreditation and to comply with the Forensic Science Regulator’s Code of Practice

Biology

- Searching and ID of blood using KM
- ID of human blood with Hematrace
- Recovery of DNA
- Blood pattern analysis
Question Document

- Validating ESDA and VSC instruments against known test samples
- Adapting operator procedures
- Testing impact of radiation protection monitoring processes

Trace Evidence & Optical Microscopy

- Recovery of “loose” material in the glove-box
- Development of procedures for instrumentation e.g. MSP, FTIR
- Evaluating tape-lift materials
Fingerprint Development

- Validation of methods for:
  - CNA fuming
  - Alternative light source imaging

Foster + Freeman Crime-lite® CL-2 & CL-82S
white, UV, violet, blue, blue-green, orange (82S)
Validation Drills

- To-date three (3) drills have been undertaken in the CFAC laboratory
  - Opportunity to test procedures, processes and adapted methods

Drill No.1

Drill No.2

Drill No.3
General Forensic Science Requirements to be Implemented at the CFAC laboratory

- In addition to the validation studies currently being undertaken the laboratory is implementing standard good practices in forensic science

- Compliance with the Home Office Forensic Science Regulator’s Code of Practice and Conduct and accreditation body requirements

- Case Management procedures and processes, e.g.
  - Exhibit Submission form
  - Evidence Continuity form
  - Communication log
Method Development

- A need to understand the effects of radiation on hairs, fibres, DNA etc
- A need to understand the effects of decontamination on hairs, fibres, DNA etc
- Refine process to maximise recovery of all evidence types
Applied Nuclear Forensic Analysis

- Classical “trace” forensics, e.g. GSR used to infer associative links
- Apply same philosophy to a Nuclear Forensic Investigation…
- Identification of particulate material on exhibits, e.g. clothing
- Simulated Nuclear Forensics crime-scene study
  - Disposable glove recovered from scene and sampled using adhesive SEM stub
  - Stub analysed using SEM/EDX

- Future work…need to developed an understand of:
  - Persistence
  - Transfer
## Summary

- The CFAC laboratory provides the appropriate environment / facility for handling exhibits contaminated with nuclear and other radioactive material.
- Experienced traditional forensic scientists are being trained to be able to operate within glove boxes with supervision.
- Current efforts are focusing on method development and validation studies.
- Gain ISO 17020/17025 accreditation for the various examination methods.
- The forensic science procedures and examinations performed within the CFAC laboratory will be to a standard acceptable in a UK Court of Law.
Thank You for Your Attention

Questions